Claims

1. A semi-conductor device (1) comprising a semi-conductor medium (2) which defines a junction (5), a first electrical contact (6) and a second electrical contact (7), the respective electrical contacts (6,7) being located spaced-apart from each other on the semi-conductor medium (2) and in electrical contact with the semi-conductor medium (2) for pumping current through the junction (5) for forming an active region (10) in the junction (5), characterised in that at least one (6) of the first and second electrical contacts (6,7) defines an outline area (12) on the semi-conductor medium (2) for determining the shape and area of the active region (10), and the at least one (6) of the first and second electrical contacts (6,7) forms an actual contact area or areas (17) in which that one (6) of the first and second electrical contacts (6,7) is in actual electrical contact with the semi-conductor medium (2), and defines non-contact areas (21) within the outline area (12) in which no electrical contact takes place between that one (6) of the first and second contacts (6,7) and the semi-conductor medium (2), and the ratio of the actual contact area (17) to the non-contact area (21) varies within the outline area (12) for varying the current density spatially in the active region (10).

2. A semi-conductor device as claimed in Claim 1 characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is varied as a function of the desired variation in the current density in the active region (10).

3. A semi-conductor device as claimed in Claim 1 or 2 characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is varied in proportion to the desired variation in current density in the active region (10).

4. A semi-conductor device as claimed in any preceding claim characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is varied in a direction in which the current density is to be varied in the active region (10).

5. A semi-conductor device as claimed in any preceding claim characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is progressively varied for progressively varying the current density in the active region (10).

6. A semi-conductor device as claimed in any preceding claim characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is varied in a transverse direction across the active region (10) relative to the longitudinal direction (11) of the active region (10) for varying the current density transversely across the active region (10).

7. A semi-conductor device as claimed in Claim 6 characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is progressively reduced towards opposite side edges (13,14) of the active region (10) which extend in a generally longitudinal direction relative to the active region (10) for progressively reducing the current density in the active region (10) towards the respective side edges (13,14).

8. A semi-conductor device as claimed in Claim 6 characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is progressively reduced towards opposite side edges (13,14) of the active region (10) which diverge away from each other in a generally longitudinal direction relative to the active region (10) for progressively reducing the current density in the active region (10) towards the respective diverging side edges (13,14).

9. A semi-conductor device as claimed in any preceding claim characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is varied in a direction longitudinally relative to the longitudinal direction (11) of the active region (10).

10. A semi-conductor device as claimed in any preceding claim characterised in that the ratio of the actual contact area (17) of the or each of the first and second

electrical contacts (6,7) is varied in directions both transversely and longitudinally relative to the active region (10).

11. A semi-conductor device as claimed in any of Claims 1 to 8 characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is arranged in a direction generally transversely of the direction in which the ratio of the actual contact area (17) to the non-contact area (21) is varying for maintaining the current density in the active region (10) substantially constant along lines of constant current density which extend in a direction generally transversely of the direction in which the ratio of the actual contact area (17) to the non-contact area (21) is being varied.

12. A semi-conductor device as claimed in any preceding claim characterised in that the shape and area of the non-contact areas (21) is such that the current density in areas of the active region (10) which correspond to the non-contact areas (21) is greater than zero.

13. A semi-conductor as claimed in any preceding claim characterised in that the shape and area of the non-contact areas (21) is such as to avoid induced grating effects in the profile of the current density in the active region (10).

14. A semi-conductor device as claimed in any preceding claim characterised in that the shape and area of the non-contact areas (21) is such as to avoid induced grating effects in the profile of the current density in the active region (10) in the direction transversely of the direction in which the current density is being varied.

15. A semi-conductor device as claimed in any of Claims 1 to 12 characterised in that the shape and the area of the non-contact areas (21) is such as to induce predetermined grating effects in the active region (10).

16. A semi-conductor device as claimed in any preceding claim characterised in that the or each of the first and second electrical contacts (6,7) comprises a main electrical contact (15) and a plurality of spaced-apart secondary electrical contacts (16) adapted to be electrically connected to the main contact (15), the main electrical

contact (15) and the secondary contacts (16) together forming the actual contact area (17) and defining the non-contact areas (21) therebetween.

17. A semi-conductor device as claimed in Claim 16 characterised in that the secondary electrical contacts (16) are electrically connected to the main contact (15).

18. A semi-conductor device as claimed in Claim 16 or 17 characterised in that the secondary contacts (16) are provided by a plurality of elongated spaced-apart substantially parallel finger contacts (16) extending from the main contact (15).

19. A semi-conductor device as claimed in Claim 18 characterised in that the finger contacts (16) forming the secondary contacts taper from their respective proximal ends (19) to their distal ends (18).

20. A semi-conductor device as claimed in any of Claims 16 to 19 characterised in that the main contact (15) extends substantially longitudinally relative to the active region (10), and the secondary contacts (16) extend transversely from the main contact (15) in a direction generally transversely of the active region (10).

21. A semi-conductor device as claimed in any of Claims 1 to 15 characterised in that the or each of the first and second electrical contacts (6,7) comprises a single contact (50) which forms the actual contact area (17), the single contact (50) having a plurality of openings (53) therethrough which form the non-contact areas (21).

22. A semi-conductor device as claimed in any preceding claim characterised in that the junction (5) defined by the semi-conductor medium is a p-n junction (5).

23. A semi-conductor device as claimed in any preceding claim characterised in that the first and second electrical contacts (6,7) are located on respective opposite surfaces (8,9) of the semi-conductor device (2) for pumping the current through the active region (10) of the junction (5).

24. A semi-conductor device as claimed in any preceding claim characterised in that the semi-conductor device (2) is an optical semi-conductor device, the

longitudinal direction (11) of the active region (10) being defined by the direction of light propagation in the active region (10).

25. A semi-conductor device as claimed in Claim 24 characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is varied for inducing a current density profile (26) in the active region (10) which substantially coincides with the desired light intensity profile (25) in the active region (10).

26. A semi-conductor device as claimed in Claim 24 or 25 characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is varied transversely across the direction (11) of light propagation in the active region (10) for inducing a current density in the active region (10), the transverse profile (26) of which substantially coincides with the desired transverse profile of light intensity (25) at the corresponding location of the active region (10).

27. A semi-conductor device as claim in any preceding claim characterised in that the first electrical contact (6) defines the outline area (12).

28. A semi-conductor device as claimed in any preceding claim characterised in that the first electrical contact (6) defines the actual contact area (17) and the non-contact areas (21).

29. A semi-conductor device as claimed in any preceding claim characterised in that the second electrical contact (7) defines the outline area (12).

30. A semi-conductor device as claimed in any preceding claim characterised in that the second electrical contact (7) defines the actual contact area (17) and the non-contact areas (21).

31. A method for spatially varying the current density in an active region (10) of a junction (5) defined by a semi-conductor medium (2) of a semi-conductor device (1), the method comprising placing a first electrical contact (6) and a second electrical

contact (7) at spaced apart locations from each other on the the semi-conductor medium (2), and in electrical contact with the semi-conductor medium (2) for pumping current through the junction (5) for forming the active region (10), characterised in that at least one (6) of the first and second electrical contacts (6,7) defines an outline area (12) on the semi-conductor medium (2) for determining the shape and area of the active region (10), and the at least one (6) of the first and second electrical contacts (6,7) forms an actual contact area or areas (17) in which that one (6) of the first and second electrical contacts (6,7) is in actual electrical contact with the semi-conductor medium (2), and defines non-contact areas (21) within the outline area (12) in which no electrical contact takes place between that one (6) of the first and second contacts (6,7) and the semi-conductor medium (2), and the ratio of the actual contact area (17) to the non-contact area (21) varies within the outline area (12) for varying the current density spatially in the active region (10).

32. A method as claimed in Claim 31 characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is varied as a function of the desired variation in the current density in the active region (10).

33. A method as claimed in Claim 31 or 32 characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is varied in proportion to the desired variation in current density in the active region (10).

34. A method as claimed in any of Claims 31 to 33 characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is varied in a direction in which the current density is to be varied in the active region (10).

35. A method as claimed in any of Claims 31 to 34 characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is progressively varied for progressively varying the current density in the active region (10).

36. A method as claimed in any of Claims 31 to 35 characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is varied in a transverse direction across the active region (10) relative to the longitudinal direction (11) of the active region (10) for varying the current density transversely across the active region (10)

37. A method as claimed in Claim 36 characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is progressively reduced towards opposite side edges (13,14) of the active region (10) which extend in a generally longitudinal direction relative to the active region (10) for progressively reducing the current density in the active region (10) towards the respective side edges (13,14).

38. A method as claimed in Claim 36 characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is progressively reduced towards opposite side edges (13,14) of the active region (10) which diverge away from each other in a generally longitudinal direction relative to the active region (10) for progressively reducing the current density in the active region (10) towards the respective diverging side edges (13,14).

39. A method as claimed in any of Claims 31 to 38 characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is varied in a direction longitudinally relative to the longitudinal direction (11) of the active region (10).

40. A method as claimed in any of Claims 31 to 39 characterised in that the ratio of the actual contact area (17) of the or each of the first and second electrical contacts (6,7) is varied in directions both transversely and longitudinally relative to the active region (10).

41. A method as claimed in any of Claims 31 to 40 characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is arranged in a direction generally transversely

of the direction in which the ratio of the actual contact area (17) to the non-contact area (21) is varying for maintaining the current density in the active region (10) substantially constant along lines of constant current density which extend in a direction generally transversely of the direction in which the ratio of the actual contact area (17) to the non-contact area (21) is being varied.

42. A method as claimed in any of Claims 31 to 41 characterised in that the shape and area of the non-contact areas (21) is such that the current density in areas of the active region (10) which correspond to the non-contact areas (21) is greater than zero.

43. A method as claimed in any of Claims 31 to 42 characterised in that the shape and area of the non-contact areas (21) is such as to avoid induced grating effects in the profile of the current density in the active region (10).

44. A method as claimed in any of Claims 31 to 43 characterised in that the shape and area of the non-contact areas (21) is such as to avoid induced grating effects in the profile of the current density in the active region (10) in the direction transversely of the direction in which the current density is being varied.

45. A method as claimed in any of Claims 31 to 42 characterised in that the shape and the area of the non-contact areas (21) is such as to induce predetermined grating effects in the active region (10).

46. A method as claimed in any of Claims 31 to 45 characterised in that the or each of the first and second electrical contacts (6,7) comprises a main electrical contact (15) and a plurality of spaced-apart secondary electrical contacts (16) adapted to be electrically connected to the main contact (15), the main electrical contact (15) and the secondary contacts (16) together forming the actual contact area (17) and defining the non-contact areas (21) therebetween.

47. A method as claimed in Claim 46 characterised in that the secondary electrical contacts (16) are electrically connected to the main contact (15).

48. A method as claimed in Claim 46 or 47 characterised in that the secondary contacts (16) are provided by a plurality of elongated spaced-apart substantially parallel finger contacts (16) extending from the main contact (15).

49. A method as claimed in Claim 48 characterised in that the finger contacts (16) forming the secondary contacts taper from their respective proximal ends (19) to their distal ends (18).

50. A method as claimed in any of Claims 46 to 49 characterised in that the main contact (15) extends substantially longitudinally relative to the active region (10), and the secondary contacts (16) extend transversely from the main contact (15) in a direction generally transversely of the active region (10).

51. A method as claimed in any of Claims 31 to 45 characterised in that the or each of the first and second electrical contacts (6,7) comprises a single contact (50) which forms the actual contact area (17), the single contact (50) having a plurality of openings (53) therethrough which form the non-contact areas (21).

52. A method as claimed in any of Claims 31 to 51 characterised in that the junction (5) defined by the semi-conductor medium is a p-n junction (5).

53. A method as claimed in any of Claims 31 to 52 characterised in that the first and second electrical contacts (6,7) are located on respective opposite surfaces (8,9) of the semi-conductor device (2) for pumping the current through the active region (10) of the junction (5).

54 A method as claimed in any of Claims 31 to 53 characterised in that the semi-conductor device (2) is an optical semi-conductor device, the longitudinal direction (11) of the active region (10) being defined by the direction of light propagation in the active region (10).

55. A method as claimed in Claim 54 characterised in that the ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is varied for inducing a current density profile (26) in the

active region (10) which substantially coincides with the desired light intensity profile (25) in the active region (10).

56. A method as claimed in Claim 54 to 55 characterised in that ratio of the actual contact area (17) to the non-contact area (21) of the or each of the first and second electrical contacts (6,7) is varied transversely across the direction (11) of light propagation in the active region (10) for inducing a current density in the active region (10), the transverse profile (26) of which substantially coincides with the desired transverse profile of light intensity (25) at the corresponding location of the active region (10).

57. A method as claimed in any of Claims 31 to 56 characterised in that the first electrical contact (6) defines the outline area (12).

58. A method as claimed in any of Claims 31 to 57 characterised in that the first electrical contact (6) defines the actual contact area (17) and the non-contact areas (21).

59. A method as claimed in any of Claims 31 to 58 characterised in that the second electrical contact (7) defines the outline area (12).

60. A method as claimed in any of Claims 31 to 59 characterised in that the second electrical contact (7) defines the actual contact area (17) and the non-contact areas (21).